

tion must be resorted to or else the farmer suffers great loss in dry years and secures a good crop only in a wet year. Dry farming attains the same average results as ordinary farming without irrigation, but with the great advantage that the farmer's crops are fairly uniform thruout the successive years and he avoids the harrowing habit of worrying over frequent droughts and the necessity of borrowing money to tide him over the loss of crops.

The methods adopted in dry farming vary in every community with the climate, the soil, and the plant to be cultivated, and it is beyond our province to enter into the details of this side of the subject. On the other hand the climatic features that render dry farming possible and wise depend essentially upon the annual quantity rather than the seasonal distribution of precipitation and evaporation. This feature belongs to climatology proper.—C. A.

SOME CLIMATIC FEATURES OF WYOMING, AND THEIR RELATION TO DRY FARMING.¹

By W. S. PALMER, Section Director. Dated Cheyenne, Wyo., February 24, 1909.

That portion of our country which is commonly spoken of as the semiarid region, and where so-called dry farming is practised, embraces a large territory which is included between the 95th and 125th degrees of longitude west of Greenwich. Within that belt of 30 degrees of longitude can be found a vast variety of climates; its topography is such that along its northern border winter temperatures of from 50° to 60° below zero may be experienced at times, while during the summer temperatures as high as 120° above zero may be recorded in the deserts of Arizona and southern California. There is, also, a great variation in the average annual precipitation of the various sections of this region, for in some of the mountain districts or along the Pacific coast the annual amounts may exceed 50 inches, while some of the desert regions have annual averages of less than 5 inches. On account of the broad area embraced within this region and the various climates that may be found therein, I wish to discuss in detail the climate of but a small portion of the semiarid region, so I shall confine my address to a discussion of some of the climatic features of Wyoming, a subject which has received my special study during the last ten years or more. While my remarks will be confined mostly to a discussion of the climate of Wyoming, they will, in general, apply to a large portion of the country which is now being cultivated by the so-called dry-farming method, Wyoming being located near the center of the dry-farming belt of the West.

During the last seventeen years a systematic collection of weather data has been made in Wyoming. In addition to the weather records which have been kept at the regular Weather Bureau stations where commissioned men are stationed, a large number of valuable records have been kept by persons who have been supplied with standard instruments by the Government and who have cooperated with the Weather Bureau in this work. The value of these records which have been voluntarily kept by the cooperative observers can not be overestimated, as they furnish data from the sections of the State where there are no regular Weather Bureau stations.

PRECIPITATION FOR WYOMING.

The most essential element in the success of dry farming is moisture, and I wish to present to you some Wyoming records regarding precipitation. From the monthly reports which have been compiled in the Cheyenne office from records kept at stations distributed over nearly all sections of the State, it has been determined that the average precipitation for the State as a whole during the last seventeen years has been 13.68 inches, or a trifle more than 13.50 inches. This average does not take into consideration the heavy precipitation which may fall in the high mountain districts where very few reliable

records have ever been kept, but it is a fair average for that portion of the State below 8,000 feet, or for all of those districts where cultivation is possible. The precipitation herein spoken of includes rainfall and snowfall, the latter being reduced to its water equivalent.

Geographical distribution of the precipitation.

While the average amount for the State is 13.68 inches, there is a wide variation in the normal amounts received over the various sections of the State. There are portions of Big Horn and Sweetwater counties where the average annual precipitation is probably less than 5 inches, while over the extreme northeastern and the extreme northwestern portions of the State there may be a few sections where the annual average is nearly 20 inches. On a map which I have prepared to accompany this paper, see fig. 1, I have endeavored to show the geographical distribution of the annual rainfall thruout Wyoming; the peculiar and complicated topography of the State causing a wide variation over the various sections. The unshaded portions of the map show areas of the State where the average annual precipitation is less than 10 inches, and you will notice that those areas embrace only portions of Big Horn County and the Red Desert region, the aggregate of which is only a small percentage of the total area of the State. I believe that most of the dry-farming experts of to-day do not advise that dry farming be attempted in regions where the annual precipitation is less than 10 inches, so the unshaded portions of the map show regions where dry-farming attempts should not be made at the present day. The darkest shadings represent areas where the average annual precipitation is in excess of 15 inches, and here again you will notice that these areas represent only a small percentage of the total area of the State. It is probable that about 75 per cent of the total area of the State is embraced within the region which receives from 10 to 15 inches annually, such areas being represented on the map by a light shading. Thus you can see that a large proportion of this State receives an average annual rainfall sufficient, so we are told by the dry-farming experts, for the successful growth of certain crops where proper methods of cultivation are followed.

Seasonal distribution of rainfall.

From the large number of monthly records which have been compiled at the Cheyenne office, covering a period of seventeen years, I have computed the average monthly precipitation for each month of the year, and have shown the amounts graphically on the accompanying chart, fig. 2. It will be noticed that the monthly amount of precipitation increases from January to May, which has the highest average of any month of the year; a gradual decrease in the monthly amount is noted from May to November which shows the lowest average for the year. From fig. 2 it can readily be seen that in this section of the semiarid region the rain falls during that time of the year when it is most needed for the crops, that is, about 70 per cent of the total annual amount falls during the six months, March to August, inclusive. There is some variation in the average amounts for the different seasons in the different sections of the State. I give below for a number of selected stations, the percentage of the total annual averages which falls during the six months, March to August:

Station.	County.	Percentage which falls March to August.
Cheyenne	Laramie	75
Buffalo	Johnson	75
Fort Laramie	Laramie	73
Laramie	Albany	72
Sheridan	Sheridan	68
Lander	Fremont	66
Bedford	Uinta	55
Evanston	Uinta	54
Border	Uinta	54
Yellowstone Park	National Park	50

¹Paper presented to Third Trans-Missouri Dry-farming Congress at Cheyenne, Wyo., February 24, 1909.

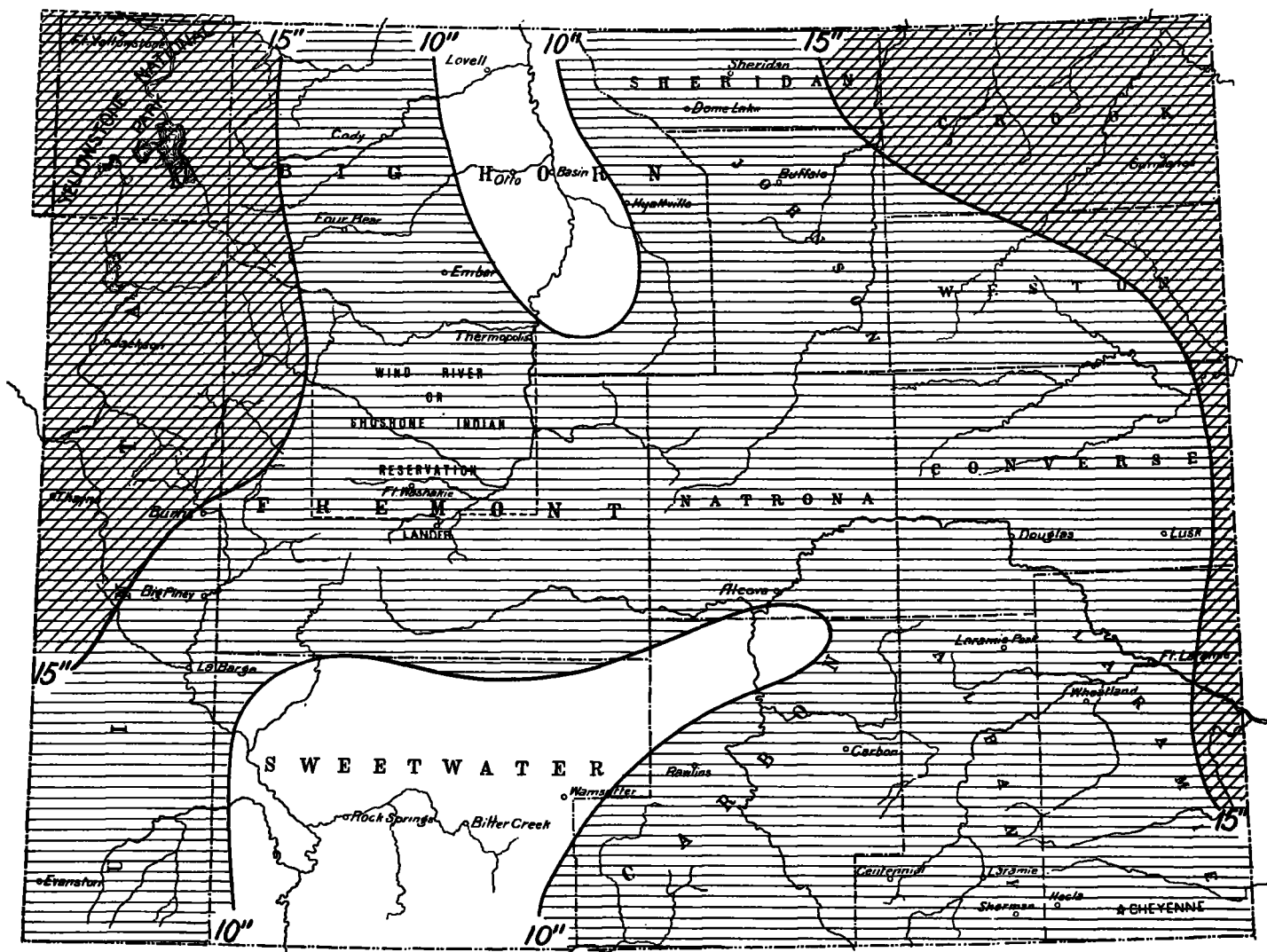


FIG. 1.—Map of the average annual precipitation over Wyoming.

From the above, it will be seen that a much greater proportion of the average annual precipitation falls during the six months period, March to August, over the eastern portion of the State than over the western counties. In Utah, less than 40 per cent of the average annual precipitation falls during that period.

Reliability of the spring precipitation.

The April–May precipitation for the State is a very reliable factor. During the last twenty-eight years there has been but one year during which the precipitation at Cheyenne has not been in excess of 2.50 inches for the two months, April and May, and that was in 1886, when it amounted to only 1.44 inches.

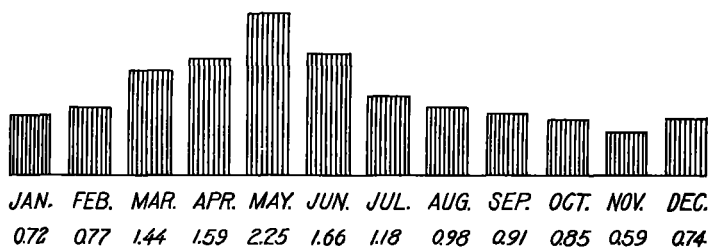


FIG. 2.—Average monthly precipitation at Cheyenne, Wyo. (averages of 17 years.)

TEMPERATURE CONDITIONS OF WYOMING.

The varied topography of the State gives a wide variation in the temperature conditions of the various sections of the State. In some sections the growing season is from four to five months in duration and summer temperatures rise to 95° or 100°, or even higher; over some of the higher agricultural districts the growing season is short, summer temperatures never rise above 95°, frosts may be experienced in any month, and only the hardier grains and vegetables can be successfully grown.

SUNSHINE.

The percentage of sunshine in Wyoming is much in excess of the percentage which is received thruout the Mississippi Valley, and this excess of sunshine is a very important factor to be considered when discussing the agricultural possibilities of the semiarid region. The actual number of hours of sunshine which a plant receives during its growing period has never, I believe, received its proper share of consideration when the length of the growing season has been under discussion; other conditions being the same, that plant will make the best progress and development which receives the greatest amount of sunshine. The percentage of sunshine received thruout the central and upper Mississippi Valley is about 45 per cent of the possible amount; in Wyoming and most of the semiarid region the percentage is 60 or above. That is, for every three hours of sunshine which is received in the Missis-

issippi Valley we receive four or more in this section of the country. Thus, if we consider the progress which should be made by growing crops by considering only the one climatic element, sunshine, the crops in the semiarid region should make as much progress in three months as the same crops would make in four months in the Mississippi Valley. I believe that the high percentage of sugar in the beets raised in this western country is due to the high percentage of sunshine which they receive during their period of growth. I do not wish to carry the discussion of this subject further, but I wish to say again that I believe that this subject has not received the consideration that it should.

SEED BREEDING.

The seedsmen of the northern districts of this country have always contended, and with good reason, that northern-grown seeds are the best; to this the seedsmen of the western districts should add that the higher the elevation at which seeds are grown, other conditions being identical, the better will be the seeds. The dry farmer can, with equally as good reason, contend that the seeds which are produced with the minimum amount of moisture for their successful production are superior to the seeds which have been grown where an excess of moisture has been used. That section of the country which combines the three conditions, namely, a northern latitude, a moderate elevation above the sea level, and a rainfall not in excess of the actual needs of plant growth, should prove to be a place where the very highest class of seeds can be produced.

EXTENSION OF FARMING DISTRICTS.

The farming belt of this country was a few years ago brought to the eastern edge of the semiarid region and within the last few years it has been rapidly covering, by irrigation and so-called dry-farming methods, large areas of what was once known as the Great American Desert. Crops are being successfully and profitably produced in regions where a few years ago it was considered that the precipitation was not sufficient to raise crops. This has not been due to a change in the climate of any part of our country, because the life of man is too short to see any change in the climate of any section; the weather of the successive years may and does vary somewhat, but our climatic conditions persist. Man has been learning how to conserve the moisture which falls, and to adapt the proper crops to the conditions of a limited rainfall. These are two lines of study which must be carried along until all of the available lands of our country, even in regions of a rainfall of less than 10 inches, can be successfully used for the production of some kind of a crop.

ATTENDANCE ON SCIENTIFIC MEETINGS.

By W. J. HUMPHREYS, Professor of Meteorological Physics. Dated Washington, January 26, 1909.

The phenomena and the processes of nature are so interdependent, and the methods of investigating them so numerous, that only he is prepared to work in any science to greatest purpose who has a sympathetic appreciation for all sciences, and an increasingly minute knowledge as his own specialty is more nearly approached. There is no exaggeration in the statement that he needs to know everything about something and something about everything, for nothing short of this can give him that accuracy and that resourcefulness essential to the solution of difficult problems, nor that alertness and breadth of view so necessary to the detection and to the understanding of new phenomena.

These statements, while universally true, apply with peculiar force to meteorology which, besides demanding a knowledge of mathematics and of every branch of physics, in one way or another comes in the closest touch with astronomy, geology, chemistry, and biology, and with practically every other science, so extensive and so profound are the effects of its phe-

nomena. And because of this intimate relation to so many sciences, it is especially important for the meteorologist to prepare articles for and to attend such important meetings as those of the American Association for the Advancement of Science, of the affiliated national and of other societies, for there are sure to be read at these meetings many papers of interest to him, and besides his own contributions are certain to receive all that attention and respect they deserve. But far better than the information he will get from the papers he will hear, or from the discussion of his own, will be the effect upon him of the enthusiasm inspired by the association thus secured, even tho temporary, with the productive scholars of the entire country; an enthusiasm that welcomes scientific difficulties and leads, thru persistent attack, to their ultimate solution.

Any one, whether public official or private citizen, whose position presupposes scholarship, and gives him an opportunity to work—and in this connection opportunity implies duty—and who does not, whenever practicable, attend such meetings, by his absence makes the absurd declaration that he can work as well without encouragement as with it; that enthusiasm to him is useless; and that acquaintance and association with the world's best scholars can do him no good, or else confesses that, neither taking part in creative work nor caring for it, he is an intellectual sluggard blocking, so far as one man can, the world's progress by filling a position for which he is utterly unworthy.

In the name of every art and of the science that is back of it, in the name of civilization and of all human progress, let no position that offers the sacred privilege of doing work be filled save by him who realizes his duty.

It would be absurd, of course, to claim that to become a productive scholar it is sufficient to attend these gatherings of scientific men (exceptional native ability, wisely and persistently trained, is the only means to such an end), but it can not be emphasized too strongly that wherever bonds outrank brains, wherever society fads pose as scientific facts and meaningless gibberish passes for profound learning, such meetings, by furnishing the encouragement his sensitive nature craves, prolong the scholar's active period and increase both the quantity and the quality of his work.

These are some of the reasons in general terms why the writer urges fuller assemblages of all scientific men. But for any meteorologist who may be disposed to ask for more specific information as to how he could be benefited, the following list of papers, selected from the many read at Baltimore before the various societies during the convocation week of December, 1908, is appended. It is not a complete list, for there were other papers the meteorologist might do well to read; but it is extensive enough to show that his branch of geophysics was not neglected, even if he himself did chance to be absent.

Prof. Edward L. Nichols. Science and practical problems of the future. (Address of the retiring president.)

Prof. Dr. Albrecht Penck, Berlin University. Man, climate, and soil. (Public address.)

Maj. G. A. Squier, U. S. A. Recent progress in aeronautics. (Public address.)

F. R. Moulton. On certain implication of possible changes in the form and dimensions of the sun, and some suggestions for explaining certain phenomena of variable stars.

Phillip Fox and Georgio Abetti. The interaction of sun-spots.

A. Galline. On the diurnal variations in the intensity of the penetrating radiation present at the surface of the earth.

John Zeleny and L. W. McKeenan. An experimental determination of the terminal velocity of fall of small spheres in air.

G. E. Hale. Solar vortices and magnetic fields.

L. A. Bauer. A plea for terrestrial and cosmical physics.